SiliconGraphics
Computer Systems

Welcome to Reality

Onyx2™ Visualization Supercomputers

Product Guide

Onyx2 InfiniteReality™ Dual Rack

Awesome Visual Computing Capabilities

- Up to 24 R10000™ processors with 4MB of secondary cache and two InfiniteReality visualization pipelines

  Or up to eight R10000 processors with 4MB secondary cache and six InfiniteReality visualization pipelines
- Up to 320MB of frame buffer
- 16 or 64MB of texture memory
- Up to 12GB of system RAM
- Up to 200GB of disk storage

Onyx2 InfiniteReality Rack

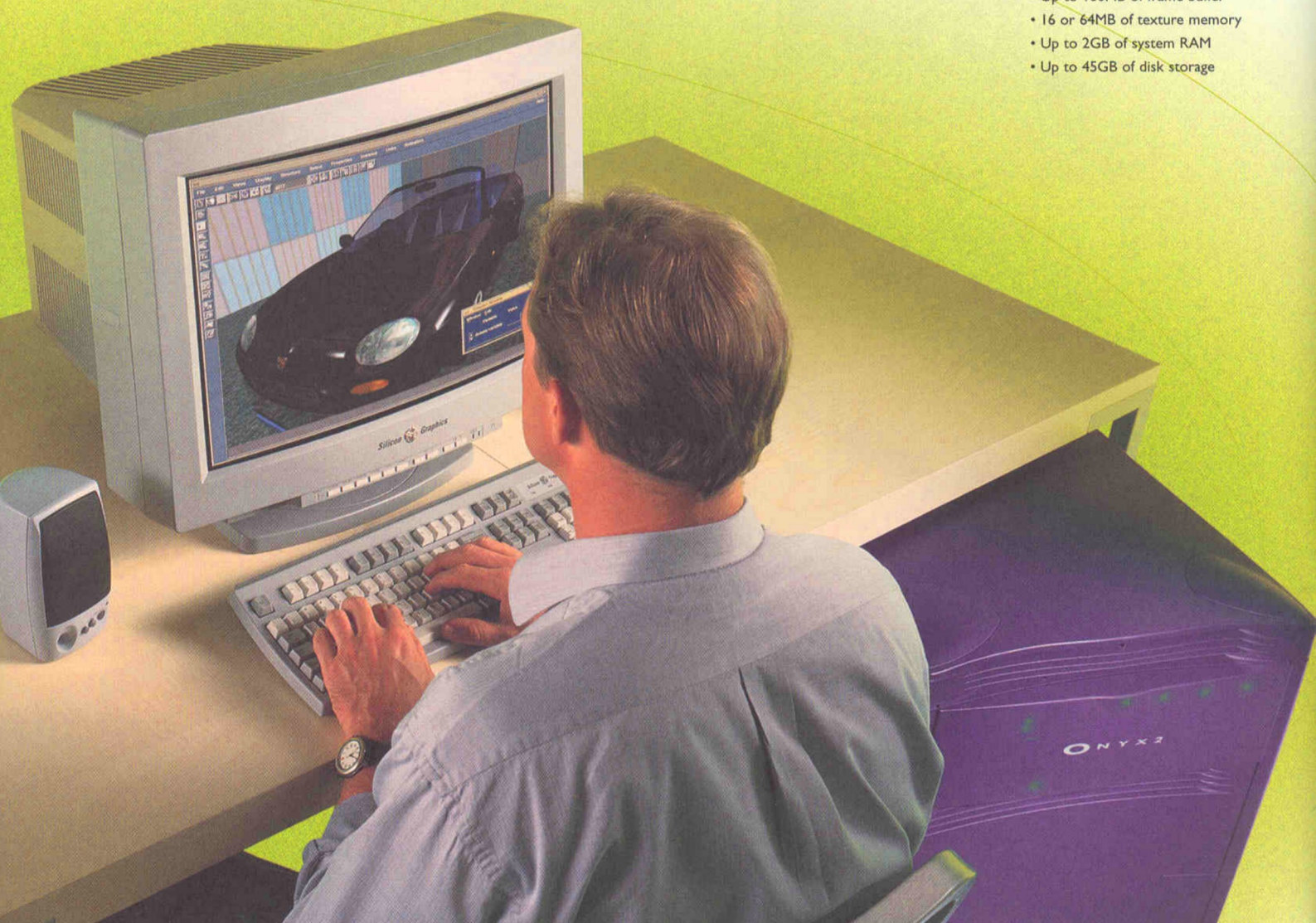
Expandable State-of-the-Art Visual Computing

- Up to eight R10000 processors with 4MB of secondary cache
- Up to two high-performance graphics pipelines
- Up to 320MB of frame buffer
- 16 or 64MB of texture memory
- Up to 4GB of system RAM
- Up to 100GB of disk storage

Onyx2 InfiniteReality Deskside

Peak Graphics Performance

- Up to four R10000 processors with 4MB of secondary cache
- Up to 160MB of frame buffer
- 16 or 64MB of texture memory
- Up to 2GB of system RAM
- Up to 45GB of disk storage



Masters of Reality

As we enter the 21st century, the global marketplace has become a reality. Expanding communication, travel, and commerce networks put you face-to-face with customers, colleagues, and competitors around the world.

In medicine, manufacturing, and defense, consistent results depend on making informed decisions with the help of advanced imaging, simulation, prototyping, and diagnostic technology. Scientists and engineers worldwide need powerful analysis and visualization tools to manipulate and understand vast amounts of data in chemistry, earth sciences, and other scientific applications. Creative film and video professionals have raised expectations for advanced realistic effects in motion pictures, broadcast, and entertainment.

To deliver the best products, services, and information possible, you need responsive, reliable tools that give you the applications, information, and images you need exactly when you need them.

Onyx2 Reality™

Unprecedented Affordability

- Up to four R10000 processors with 1MB of secondary cache
- Up to 80MB of frame buffer
- 16 or 64MB of texture memory
- Up to 2GB of system RAM
- Up to 45GB of disk storage

The Fastest Graphics on the Planet

Welcome to reality—unrivaled Onyx2 visual supercomputers from Silicon Graphics. Onyx2 systems simultaneously process graphics, imaging, and video data in real time and are designed to tackle the most demanding visual computing challenges in manufacturing, industrial design, entertainment, oil and gas, and visual simulation.

Built on the groundbreaking Scalable Shared-memory Multi-Processing (S2MP™) architecture, Onyx2 systems will impress you with incredible performance, flexibility, and affordability. With S2MP technology, Silicon Graphics creates highly configurable computer modules featuring scalable system bandwidth and low-latency memory access while maintaining a familiar environment for applications programmers.

New Era in Visual Supercomputing

The entire Onyx2 family features high-performance MIPS® RISC processors, the high-bandwidth S2MP architecture, proven Geometry Engine® processor technology, and exceptional development tools. This robust product line allows you to scale graphics, computational power, memory, storage, and networking technology to meet a wide range of application requirements. From the fastest graphics systems ever seen to affordable multiprocessing deskside workstations, Onyx2 systems fit your performance needs and your budget.

Geometry Engine Processor ➤

High-performance Geometry Engine processors perform lighting calculations and geometric transformations such as translation, rotation, and scaling. They also execute image processing functions such as convolution and histogram equalization.

Onyx2 Designed for Performance

All Onyx2 systems use extensive parallelism to avoid bottlenecks and produce unequaled visual realism. Complex images with effect filters and texture mapping are created at real-time rates. Sophisticated full-scene anti-aliasing, multisampling, transparency, and bicubic interpolation capabilities make Onyx2 graphics systems unlike anything you've seen before.

Stunning Displays in Real Time

Unprecedented system and graphics features enable Onyx2 to render innovative effects. Alpha blending simulates cockpit canopies, smoke, clouds, and other transparent objects. Hardware-accelerated imaging capabilities speed convolution, histogram, and lookup table functions. Dynamic resampling optimizes update rates for smooth visual simulations.

SuperWide™ Monitors—The New Standard for Immersive Visualization

Onyx2 systems support a new 24-inch ultra-high-resolution 1920x1200 color monitor. This SuperWide technology provides superior image quality, increased on-screen working area, and more compelling visual presentations with a state-of-the-art 16:10 aspect ratio. This monitor is standard on Onyx2 InfiniteReality systems and available as an option on Onyx2 Reality.

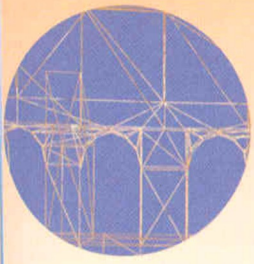
Interactive Imaging and Volume Rendering

In addition to unequaled polygon-rendering performance, Onyx2 systems enable you to visualize data acquired from diverse origins—from image processing to volume rendering. Imagine reconstructing a series of two-dimensional images into a three-dimensional volume. By continuously resampling in three dimensions, Onyx2 visual supercomputers allow you to rotate, translate, filter, and manipulate volume data in real time.

More per Cycle—MIPS R10000 RISC Processor

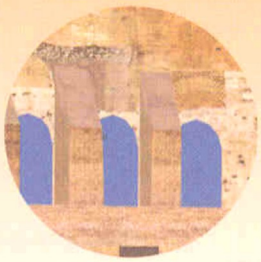
The 64-bit MIPS R10000 processor delivers the incredible compute performance driving all Onyx2 systems. The superscalar R10000 microprocessor delivers exceptional processing power.

- High clock rate accelerates every system function
- Four-way superscalar architecture reduces processor bottlenecks
- Out-of-order execution utilizes idle processing units
- Speculative execution reduces execution time
- Huge nonblocking cache keeps essential data in fast memory



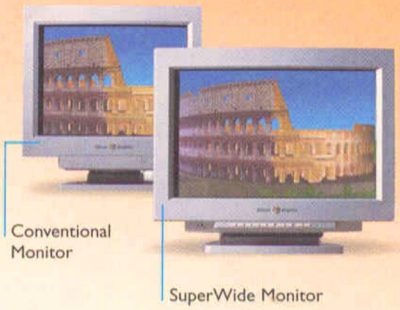
Raster Manager ➤

Raster Managers (RMs) scan-convert data from Geometry Engine processors into digital images. RMs perform pixel operations including z-buffer testing, color and transparency blending, texture mapping, and multisample anti-aliasing at real-time rates.



Display Generator ➤

The Display Generator (DG) converts digital data from the RMs into analog video signals for display. A two-channel DG provides one high-resolution analog output and a second high-resolution analog or NTSC/PAL output. An optional eight-channel DG provides up to eight distinct analog ouputs.



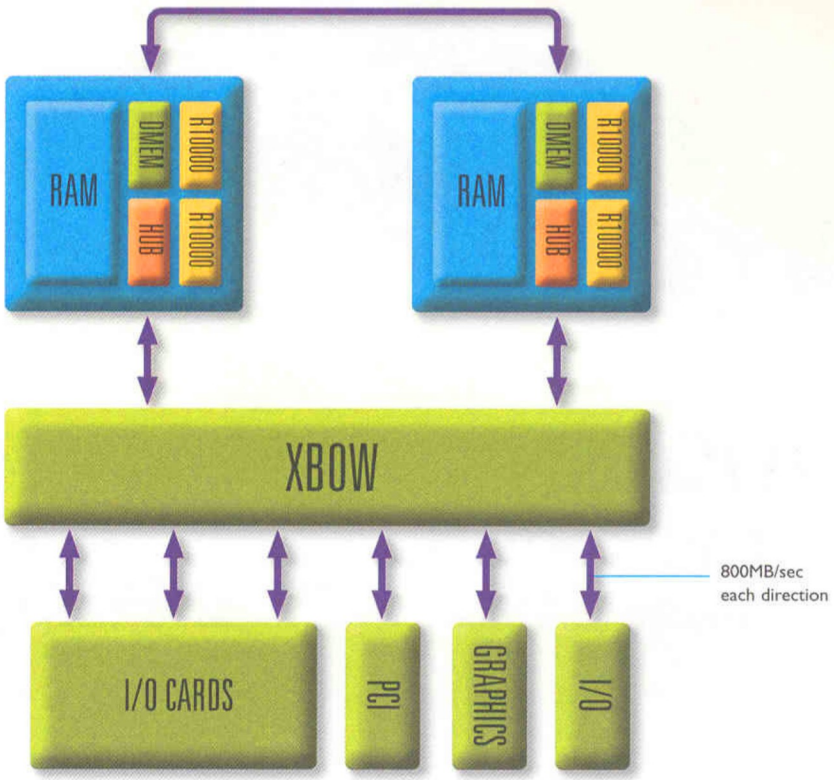
Maximum Bandwidth with the S2MP Architecture

Drawing on a decade of experience designing high-performance, multiprocessing supercomputers, Silicon Graphics created the revolutionary S2MP architecture. S2MP architecture systems eliminate the bottleneck associated with bus-based designs by using multiple high-bandwidth crossbar interconnects.

On the Onyx2 rack systems, the unique S2MP architecture allows you to integrate additional modules anytime you need more processing power, main memory, I/O connectivity, graphics, or system bandwidth.

Four-Processor Deskside System

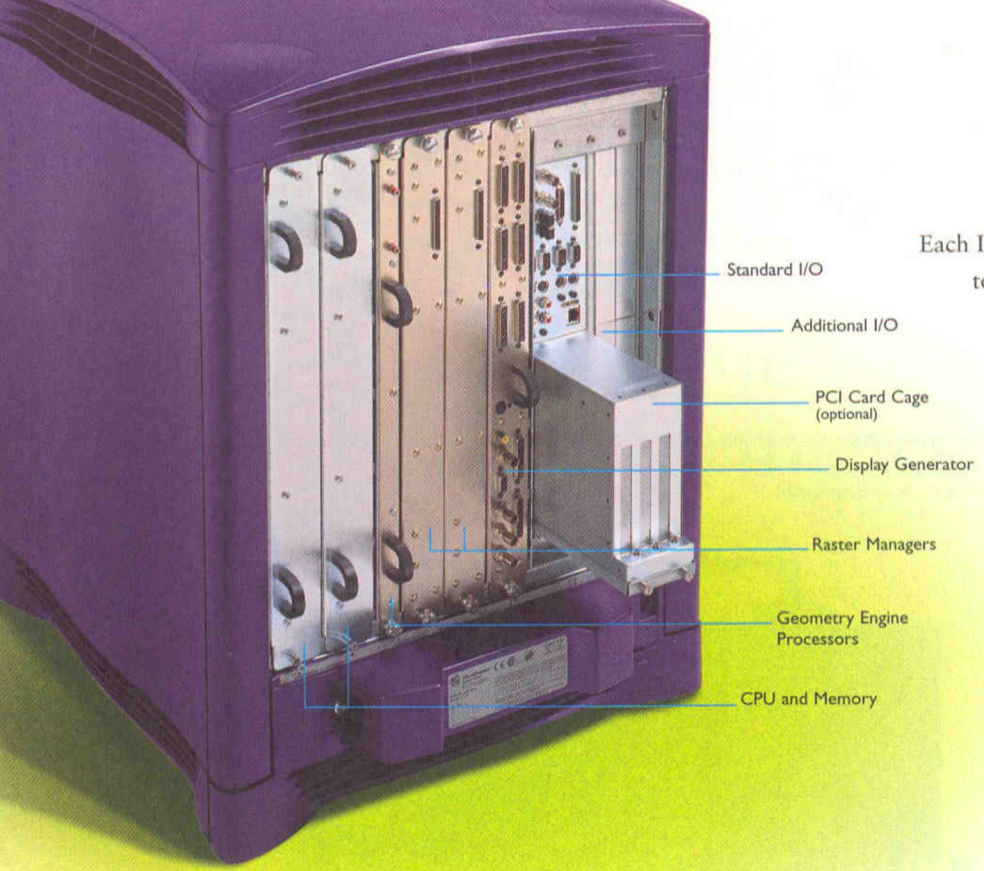
The Onyx2 fast bidirectional interconnects eliminate bottlenecks.



Onyx2 RealityMonster™ Combining Visualization Pipelines

The high system bandwidth and low memory latency unique to the S2MP architecture make it possible to combine multiple InfiniteReality pipelines, focusing awesome power on the most demanding visual applications. This revolutionary ability delivers increased frame update rates for complex geometries and increased texture memory to enable huge volume rendering.

Using OpenGL® library calls, Onyx2 RealityMonster delivers an astounding 80 million polygons per second and a 5.3-billion-pixels-per-second fill rate. For cutting-edge visual simulation, digital prototyping, 3D rendering, defense imaging, and advanced visualization, nothing else comes close to the visualization and computational capabilities of Onyx2 RealityMonster.



Under the Hood

Onyx2 systems bring together the most advanced components with innovative interconnect technology. From a unique memory architecture to flexible peripheral connectivity, every aspect of Onyx2 technology contributes to unrivaled performance and versatility.

High-Performance Memory

In the S2MP architecture, processors seamlessly address data in cache memory, local RAM, and remote RAM on other processor modules. Each processor/memory node provides connectivity for up to two processors and a full gigabyte of RAM. Onyx2 systems minimize memory access latency by using high-performance synchronous DRAM technology.

Fast-Access, High-Capacity Disk Storage

To keep extremely large graphics, imagery, and video data files moving quickly, Onyx2 systems use 4.5 gigabyte or 9.1 gigabyte drives running at Ultra SCSI data transfer rates of up to 40 megabytes per second. For even more demanding applications, optional Fibre Channel disks deliver a full 100-megabyte-per-second transfer rate.

High-Performance Connectivity

Onyx2 visual supercomputers feature versatile networking options including industry-standard Ethernet™, HIPPI, and FDDI interfaces. Fibre Channel and Asynchronous Transfer Mode connections, including ATMOC3, take network capabilities to a new level of communications performance.

Each I/O device is connected with a nonblocking point-to-point interconnect running at 800 megabytes per second. With unrivaled system bandwidth, I/O devices in Onyx2 systems operate at peak performance, avoiding bandwidth contention among graphics, video, storage, and other I/O.

Integrating Low-Cost Peripherals with PCI

The optional Peripheral Component Interconnect (PCI) local bus gives Onyx2 systems access to a wide range of affordable peripherals. The PCI bus supports 32-bit and 64-bit PCI boards with a peak bandwidth of 264 megabytes per second. Low cost and industry standardization make PCI an excellent solution for meeting connectivity requirements.

VME for Custom Peripherals

For applications requiring VME connectivity, an optional VME adapter interface is available. VME devices map directly into virtual address space, providing easy-to-program interfaces for system integrators.

Standard on every Onyx2 system is the ability to connect an NTSC/PAL composite or S-Video VCR to record screen images in real time.

Video Reality

If your version of reality includes video input and output, optional equipment makes Onyx2 systems ideal for the professional studio environment.

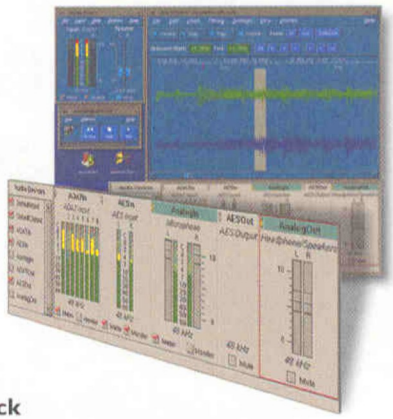
Graphics-to-Video Option (GVO)

For applications requiring CCIR 601 digital video and alpha output from graphics in real time, GVO provides a low-latency solution.

Digital Video Option (DIVO)

DIVO routes multiple video and audio streams to and from system memory or disk. In conjunction with the Onyx2 graphics subsystem, broadcast-quality video maps directly onto any three-dimensional surface while image processing functions enhance the video stream in real time.

DIVO connects Onyx2 systems to industry-standard CCIR 601, SMPTE 259, and SMPTE 272 equipment.



Built-in digital audio tools

Professional Audio Sampling and Playback

All Onyx2 systems include 24-bit digital audio input and output. The Onyx2 audio system provides 3.5mm and RCA jack connectors for connection to analog audio equipment, such as the included amplified speakers. Optical connectors and 75 ohm BNC jacks connect Onyx2 with AES/EBU and ADAT 8-channel equipment for up to 10 channels of 24-bit digital audio. Built-in video reference input and loop-out lock Onyx2 audio to a video house sync signal.

Productive, Familiar Software Environment

Onyx2 systems use the state-of-the-art, 64-bit Cellular IRIX™ operating system from Silicon Graphics. Cellular IRIX is based on industry-standard UNIX® System V Release 4 technology. Innovative software technology maintains a familiar, shared-memory programming environment and provides backward compatibility with existing applications, while new capabilities support extensive scalability and high-availability features.

Fast, Robust Filesystem

For fast file access, integrated volume management, and guaranteed I/O rates, Silicon Graphics created the 64-bit XFS™ filesystem. XFS uses advanced journaling technology to maintain data integrity and supports unmatched capacities with files and filesystems to 9 million terabytes and millions of files in a single directory.

Real-Time Performance

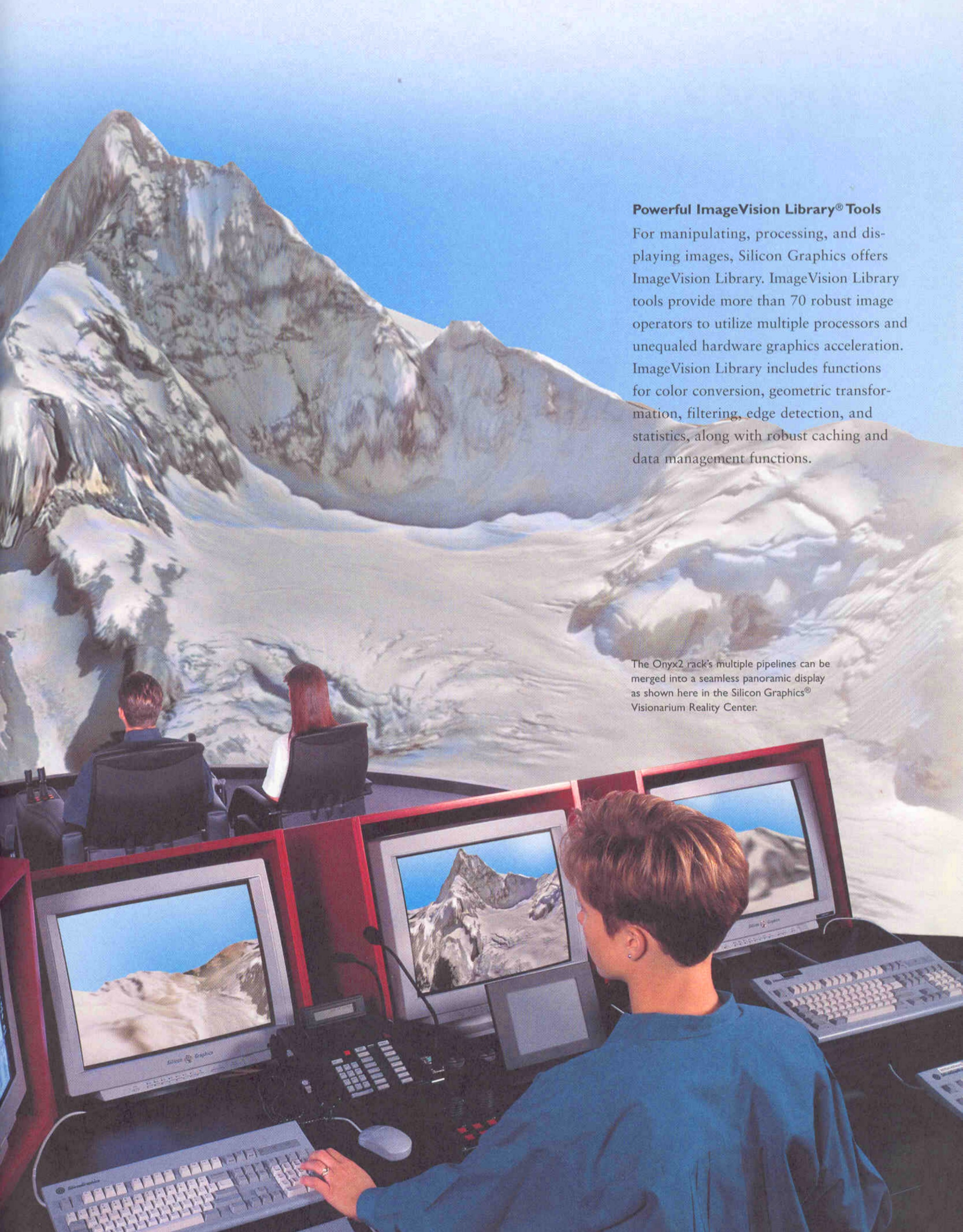
The REACT™ extensions for Cellular IRIX deliver deterministic performance capabilities for real-time applications. Fully compliant with POSIX 1003.b standards, REACT tools give you control over system overhead, process priority, processor allocation and scheduling, real-time disk access, and synchronization to external events.

Industry-Standard OpenGL Graphics

Application programmers access Onyx2 graphics through the industry-standard OpenGL development environment. OpenGL provides platform-independent 3D functionality, including operators for geometric and raster primitives, viewing and modeling transformations, and portable 3D scene description.

Developing with IRIS Performer™

The IRIS Performer development environment extends OpenGL functionality with tools for creating real-time interactive graphics applications. IRIS Performer optimizes graphics performance by balancing processor allocation and image detail to deliver a constant frame rate.



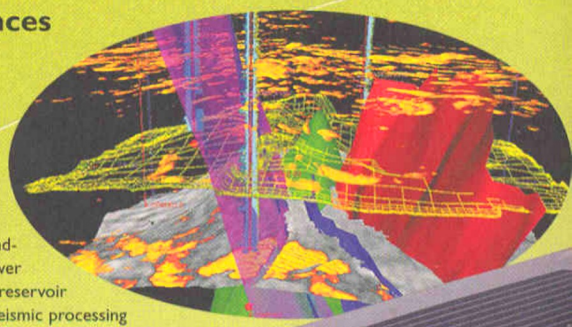
Powerful ImageVision Library® Tools

For manipulating, processing, and displaying images, Silicon Graphics offers ImageVision Library. ImageVision Library tools provide more than 70 robust image operators to utilize multiple processors and unequaled hardware graphics acceleration. ImageVision Library includes functions for color conversion, geometric transformation, filtering, edge detection, and statistics, along with robust caching and data management functions.

The Onyx2 rack's multiple pipelines can be merged into a seamless panoramic display as shown here in the Silicon Graphics® Visionarium Reality Center.

Onyx2 in Your World

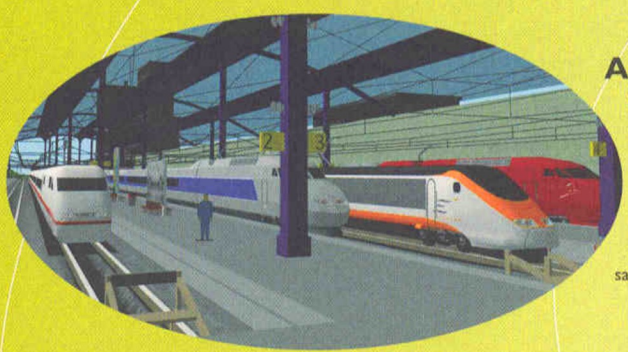
Earth Sciences
Making Better Decisions



Onyx2 systems help you understand very large 3D seismic surveys without lengthy delays. Superior processing power and system bandwidth combine to deliver unrivaled capacity for reservoir characterization and seismic processing and visualization, including volume rendering.

Interactive Entertainment
Creating Virtual Worlds

Captivate your audience with sensational graphics and fluid animation made possible by advanced Onyx2 systems. Multiple geometry pipelines and multiple channels per pipeline reduce your cost per seat and help you create challenging virtual adventures for the location-based entertainment industry.



Architectural Design and Construction
New Tools and Techniques

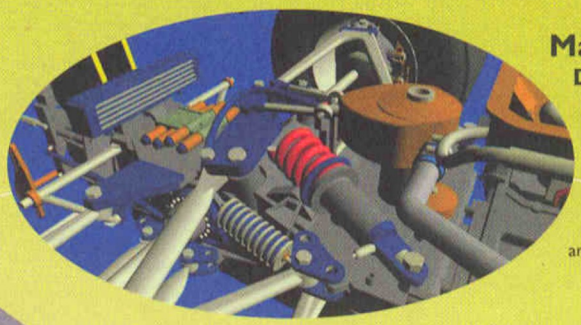
With advanced real-time image generation, Onyx2 systems give architects and planners the ability to interactively visualize the entire design process. High-quality rendering creates realistic images of the architectural space. Before actually pouring concrete, virtual construction can literally save millions of dollars.

Film, Video, and Broadcast
Unlimited Creativity for Entertainment

From high-performance compositing and editing to virtual sets and performance animation technology, Onyx2 systems deliver the most powerful creative solutions available for post-production and digital television. Advanced system architecture and extraordinary graphics performance provide exceptional throughput, resulting in more time creating and less time waiting.

Defense Imaging
Real-Time Performance with Real-World Data

The scalable system architecture provides the power to acquire and merge gigapixel images, detailed 3D terrain, live video, and volume renderings for powerful situation analysis in mission-critical applications. Superior computational power and system bandwidth deliver unparalleled data fusion capabilities for imagery exploitation, mission planning, and battlefield visualization.



Manufacturing

Design to Production in Record Time

Interactive digital prototypes help engineers locate and analyze potential problems much faster than with conventional production development. Engineering analysis tools reveal methods to optimize products for lower cost and improved quality.

Scientific Visualization

Unlocking Reality

Onyx2 technology combines the computational power of a supercomputer with the world's fastest interactive computer graphics to give you greater insight into scientific data. Breakthrough processor, system, and graphics performance allow you to steer virtual experiments and visualize large data sets in a truly scalable environment.

Visual Simulation

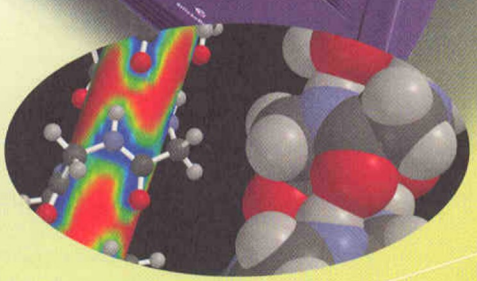
The Real World in Real Time

Onyx2 InfiniteReality systems deliver photo-realistic, real-world density scenes free from distracting visual anomalies even at extremely high resolutions. Combined with scalable Onyx2 computing power, Onyx2 InfiniteReality graphics provide unrivaled capabilities for advanced modeling and simulation.

Medical Imaging

Better Diagnostic Insight

Magnetic resonance imagers and computed tomography scanners produce overwhelming quantities of image data. Onyx2 visual supercomputers merge this data using interactive volume rendering. Multiple processors and real-time capabilities make Onyx2 the platform of choice for advanced medical imaging research.



Virtual Reality

Creating the Immersive Experience

A single Onyx2 Reality system drives fully textured, real-time, immersive environments for up to eight simultaneous participants. Distributed simulation tools and networking facilities enable multiuser networking across the room or around the world.

Chemistry

The Leading Edge

Unparalleled interactive 3D modeling and stereo viewing allow you to inspect, probe, and manipulate large, complex molecules in real time. Advanced Onyx2 texture mapping techniques filter and highlight specific molecular properties for faster insight.

Onyx2
Technical Specifications

	Onyx2 Reality	Onyx2 InfiniteReality Deskside	Onyx2 InfiniteReality Rack	Onyx2 InfiniteReality Dual Rack	Onyx2 RealityMonster**
GRAPHICS					
Polygons/sec	5.5M	11M	11M	11M	80M
Pixel fill, smooth, Z	224M to 448M	224M to 448M	224M to 896M	224M to 896M	5.3 gigapixels/sec
Pixel fill, textured, AA	67M to 135M	194M to 388M	194M to 776M	194M to 776M	4.7 gigapixels/sec
Anti-aliased vectors/sec	3.7M	7.4M	7.4M	7.4M	60M
Trilinear interpolations/sec	100M to 200M	200M to 400M	200M to 800M	200M to 800M	6.4G
Convolutions/sec (5x5)	30M	60M	60M	60M	TBD
Voxels/sec	100M to 200M	200M to 400M	200M to 800M	200M to 800M	4.8G
24-bit floating-point Z	yes	yes	yes	yes	yes
Color	48-bit RGBA	48-bit RGBA	48-bit RGBA	48-bit RGBA	48-bit RGBA
Overlay planes	16	16	16	16	16
Anti-aliasing multisampling	4x4	8x8	8x8	8x8	8x8
Max. bits/pixel	128 to 512	256 to 2048	256 to 2048	256 to 2048	256 to 2048
Graphics pipelines	1	1	1 to 2 (1 4RM, 1 2RM)	1 to 6*(3 4RM, 3 2RM)	4 to 8 (4 4RM, 4 2RM)
Geometry Engine processors/pipeline	2	4	4	4	4
Raster Managers/pipeline	1 to 2	1 to 2	1 to 4 and 1 to 2	1 to 4 and 1 to 2	1 to 4 and 1 to 2
Texture memory/pipeline	16 or 64MB	16 or 64MB	16 or 64MB	16 or 64MB	16 or 64MB
Frame buffer size/pipeline	40 to 80MB	80 to 160MB	80 to 320MB	80 to 320MB	80 to 320MB
Display channels/pipeline	2 or 8	2 or 8	2 or 8	2 or 8	2
Display capability	VGA to HDTV	VGA to HDTV	VGA to HDTV	VGA to HDTV	VGA to HDTV
Std. monitor size resolution	20" 1280x1024	24" 1920x1200	24" 1920x1200	24" 1920x1200	24" 1920x1200
COMPUTER PLATFORM					
CPU	MIPS R10000	MIPS R10000	MIPS R10000	MIPS R10000	MIPS R10000
Quantity	1 to 4	2 to 4	2 to 8	2 to 24*	8 to 16
Primary caches (ins./data)	32KB/32KB	32KB/32KB	32KB/32KB	32KB/32KB	32KB/32KB
Secondary cache	1MB	4MB	4MB	4MB	4MB
RAM memory	64MB to 2GB	64MB to 2GB	64MB to 4GB	64MB to 12GB	256MB to 8GB
Disk storage (internal)	1 to 5 4.5GB or 9.1GB 3.5" Ultra SCSI	1 to 5 4.5GB or 9.1GB 3.5" Ultra SCSI	1 to 11 4.5GB or 9.1GB 3.5" Ultra SCSI or 10 3.5" Fibre Channel**	1 to 22 4.5GB or 9.1GB 3.5" Ultra SCSI or 20 3.5" Fibre Channel**	1 to 22 4.5GB or 9.1GB 3.5" Ultra SCSI or 20 3.5" Fibre Channel**
Expansion slots	4 (optional 3-slot PCI)	4 (optional 3-slot PCI)	8 (optional 3-slot PCI)	8 to 24* (optional 3-slot PCI)	16 (optional 3-slot PCI)
Dimensions	25.5" H, 23" D, 21" W 65cm H, 58cm D, 53cm W	25.5" H, 23" D, 21" W 65cm H, 58cm D, 53cm W	73" H, 40" D, 28" W 185cm H, 102cm D, 71cm W	73" H, 40" D, 56" W 185cm H, 102cm D, 142cm W	73" H, 40" D, 84" W 185cm H, 102cm D, 213cm W
Weight (max. configuration)	215 lbs (98kg)	215 lbs (98kg)	800 lbs (364kg)	1,600 lbs (727kg)	2,400 lbs (1091kg)
Standard monitor weight	71.6 lbs (32.5kg)	90.2 lbs (41kg)	90.2 lbs (41kg)	90.2 lbs (41kg)	90.2 lbs (41kg)
ELECTRICAL AND POWER					
Voltage	110 to 220 VAC	110 to 220 VAC	220 VAC single phase	220 VAC single phase	220 VAC single phase
Frequency	50 to 60Hz	50 to 60Hz	50 to 60Hz	50 to 60Hz	50 to 60MHz
Power	2,500 watts	2,500 watts	7,000 watts	14,000 watts	21,000 watts
Heat dissipation	8,500BTU/hr	8,500BTU/hr	23,900BTU/hr	47,800BTU/hr	71,700BTU/hr
Electrical service type (110 VAC capabilities are configuration limited)	NEMA5-20, 110 VAC @ 20A; NEMA6-20, 208 VAC @ 20A	NEMA5-20, 110 VAC @ 20A; NEMA6-20, 208 VAC @ 20A	2xNEMA6-30, 208 VAC @ 30A	3-5xNEMA6-30, 208 VAC @ 30A	7xNEMA6-30, 208 VAC @ 30A
Noise	50 dBa	50 dBa	65 dBa	68 dBa	70 dBa

I/O, NETWORKING, AND COMMUNICATION

Standard data	40MB/sec Ultra SCSI, 10Base-T/100Base-TX Ethernet, 4 460 kbaud asynchronous serial ports, 2 keyboard ports, 2 mouse ports, parallel port
Standard audio	2.75 ohm BNC AES/EBU stereo in/out, 2 optical ADAT 8-channel in/out, RCA phono jack stereo line-level input output, 3.5mm stereo analog headphone output, mono microphone input jack
Optional data	XIO to PCI adapter (1 full-height, 2 double-height slots, 132 to 264MB/sec), XIO to VME adapter (6U), FDDI single attach, FDDI dual attach, UTP FDDI, Token Ring, ISDN, high-speed synchronous serial, 100MB/sec Fibre Channel** (2 port), 40MB/sec Ultra SCSI (4 port), 100Base-TX (4 port) combined with 460 kbaud asynchronous serial (6 ports), ATMOC3 (4 port), DIVO in/out (CCIR601, SMPTE 259)

REMOVABLE MEDIA

Standard	CD-ROM
Optional	DDS-2 (DAT), 8mm Exabyte, DLT tape

ENVIRONMENTAL (NON-OPERATING)

Temperature	-20° to +60° C
Humidity	10% to 95% non-condensing
Altitude	40,000 MSL

ENVIRONMENTAL (OPERATING)

Temperature	+5° to +35° C altitude 5,000 MSL, +5° to +30° C altitude 10,000 MSL
Humidity	10% to 90% non-condensing

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Computer Systems

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Specifications and performance preliminary.

*InfiniteReality dual-rack configurations trade-off CPU capacity versus graphics capacity. An eight-processor dual-rack system can have six pipes. A 24-processor dual-rack system can have two pipes.

**Available first half 1997. RealityMonster performance for eight pipelines.

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